Original Article

Evaluation of soft and hard tissue changes after bimaxillary surgery in class III orthognathic surgery and aesthetic consideration

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ABSTRACT

Aims: The aim of this study was to evaluate hard and soft tissue change after bimaxillary surgery in class III patients by focusing on sella, nasion, A point (SNA) and sella, nasion, B point (SNB) angle and aesthetic outcome. **Materials and Methods:** The sample consisted of 96 skeletal Class III patients (42 women, 54 men) with a mean age of 25 years with standard deviation (SD) of 8.4. The youngest patient was 16-years-old and the oldest 51-years-old at the time of surgery. In total, seven skeletal parameters, eight soft tissue parameters, and two dental parameters were evaluated on the cephalograms. **Result:** At the beginning of the treatment 49 Patients had SNA between 80° and 84°, 34 had SNA of less than 80° and 13 had SNA of more than 84°. Post surgically, 25 patients had SNA of 78°–84°, 19 had SNA less than 78° and 52 patients had SNA of more than 84°. Out of 96 patients 22 had SNB of 78°–82° before surgery, 16 had less than 78° and 58 had SNA of more than 84°. Postoperatively, we measured SNB of 78°–80° in 42, less than 78° in 18 and of more than 82° in 36 patients. The inclination of the maxilla relative to the cranial base changed from 7.2° (SD = 4)–8° (SD = 5.1) and the mandible changed from 35.7° (SD = 6.6) to 36° (SD = 6.3) postoperatively which was not significant. The distance from upper lip to E-line increased by 2.6 mm (SD = 3.9) after surgery ($P < 0.001$), while, the lower lip distance to E-line decreased slightly by 0.9 mm (SD = 3.2) ($P < 0.01$). Nasolabial angle was decreased by 9.5° (SD = 9.4) after surgery ($P < 0.001$). The nose prominence also decreased from 18.2 mm (SD = 3.5) –16.5 mm (SD = 3.3). **Conclusion:** Although in many cases we did not have a SNA angle or SNB angle in normal range but a good aesthetic outcome have been observed. Consequently our study showed that soft tissue change and aesthetic aspects should be considered in surgical planning and achieving SNA angle or SNB angle of norm range should not be the only goal. As we could show the advancement of maxilla will result in a better lip and nose profile and this should be considered in treatment planning.

Key words: Aesthetic consideration, bimaxillary surgery, Class III, Class III orthognathic surgery, soft tissue and hard tissue changes

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Introduction

Orthognathic surgery has optimized the treatment of skeletal class III malocclusion after growth spurt. Maxillary advancement, mandibular setback, and bimaxillary osteotomy are three basic options to correct this deformity. It is not only crucial to achieve a good

functional result but harmonious aesthetic outcome is also very important. In order to plan the desired outcome we should be able to predict the soft tissue changes in addition to hard tissue movement. Various studies had tried to evaluated the soft tissue changes following bimaxillary osteotomy after correction of Class III deformity.[1] Furthermore many studies have evaluated the precision of these computerized programs concerning the prediction of postoperative profile following different surgical procedures.[2-4] Chew found that the hard and soft tissue movements following bimaxillary surgery were strongly correlated in the horizontal, but not vertical direction.[5] The study by Enacar *et al*., suggested that the soft tissue responses to bimaxillary osteotomy were similar to those seen in mandibular setback surgery alone with exception of the changes in nasal tip projection and the upper-lip area.[6] Louis *et al*., found that in patients undergoing maxillary advancement without adjunctive nasal soft tissue procedures, the superior rotation of the soft tissue points was directly related to the horizontal movement of the maxilla.[7] All these literature and many others have shown different soft tissue changes due to the hard tissue repositioning. The aim of this retrospective cephalometric study was to examine the changes in soft tissue profile depending on maxilla relocation following bimaxillary osteotomy to correct class III deformity considering aesthetic outcome.

Materials And Methods

Sample selection

Samples were selected from all patients who were treated at University Hospital (X) from 1994–2011. All the patients fulfilled the following criteria:

- Patients who had Le Fort I advancement combined with bilateral sagittal split osteotomies (BSSO)
- Patients who received presurgical orthodontics
- The availability of preoperative and postoperative cephalograms
- Patients with cleft lip and palate and other congenital craniofacial anomalies were excluded

Presurgical cephalograms (T1) were taken before the orthodontic treatment, and a postsurgical cephalograms (T2) were obtained about 8 weeks after the surgery. All radiographs were taken in neutral head position with teeth in maximal intercuspidation and relaxed lip. The pre- and postsurgical cephalograms were digitized by using the ONYX software (Onyx Ceph Version 2.7.8, Image Instruments, Chemnitz, Germany) by one examiner. The horizontal reference line was constructed 7° below the sella-nasion line, and a perpendicular plane to this reference line at nasion was used as the vertical reference line. The hard tissue landmarks and soft tissue landmarks were measured in millimetres in relation to both the horizontal and vertical reference lines of both the pre- and postsurgical cephalograms to evaluate surgical movements and soft tissue changes.

We used following linear and angular measurements before and after surgery: Sella, nasion, A point (SNA), sella, nasion, B point (SNB), A point, nasion, B point (ANB), Wits, Angle between articular, gonion and menton (Ar-Go-Me), and maxillary inclination relative to the cranial base (NL to NSL) and mandibular inclination relative to the cranial base (ML to NSL), angle between long axis upper central incisor and anterior cranial base (U1 to SN), angle between the long axis of the lower central incisor and mandibular plane (IMPA), Upper Lip to E-line (Upper Lip-E), Lower Lip to E-line (Lower Lip-E), Nasolabial angle (NA), Nose Prominence (PN), Soft tissue chin thickness (Pg')), upper lip length (UPLL), lower lip length (LOLL), Cervical Length (distance between soft tissue pogonion and cervical point which is the point from mandible to throat).

Statistical analysis was performed with the SPSS statistical software program (version 18.0; SPSS, Chicago, IL). All soft tissue changes were related to bony changes in the horizontal and vertical dimensions by means of analyses of the Pearson correlation coefficient. To check for statistical significance of quantitative variables the paired sample *t*-test was used. All data are expressed as mean values, denoting a P value of ≤ 0.05 as significant. The reliability of measurements and the errors of the method were determined by randomly selecting 30 cephalograms before and after surgery. The same investigator digitized cephalograms after 2 weeks. The standard deviation (SD) of error of each measurement was calculated by Dahlberg's formula[8] ($\sqrt{\Sigma D2/2N}$); where D is the difference between the first and second measurements and N is the number of double determinations.

Results

The sample consisted of 96 skeletal Class III patients (42 women, 54 men) with a mean age of 25 years (SD = 8.4). The youngest patient was 16-years-old and the oldest one was 51-years-old at the time of surgery.

Sagittal and vertical hard tissue changes

The main surgical changes were the advancement of the maxilla with an increase of theSNA angle from 79.7° (SD = 4.8)–83° (SD = 5) ($P < 0.001$) and a mandibular posterior movement with a decrease of the SNB angle from 83° (SD = 5.5) 80.7° (SD = 5). The Wits value increased by 7 mm (SD = 4) and was significant ($P < 0.001$). At the beginning of the treatment 49 patients had SNA between 80°–84°, 34 had SNA of less than 80° and 13 had SNA of

more than 84°. Postsurgically, 25 patients had SNA of 78°–84°, 19 had SNA less than 78° and 52 patients had SNA of more than 84°.

Out of 96 patients 22 had SNB of 78°–82° before surgery, 16 had less than 78° and 58 had SNA of more than 84°. Postoperatively we measured SNB of 78°–80° in 42, less than 78° in 18 and of more than 82° in 36 patients.

The inclination of the maxilla relative to the cranial base changed from 7.2° (SD = 4)–8° (SD = 5.1) and the mandible changed from 35.7° (SD = 6.6) 36° (SD = 6.3) postoperatively and was not significant [Tables 1 and 2].

Dental changes

The angle between the upper central incisor and the SN plane decreased significantly from 106.7° (SD = 8.8)–104.9° (SD = 8.6), while IMPA increased by 4.8° (SD = 7.2) ($P < 0.001$) [Table 3].

Soft tissue changes

The distance from upper lip to E-line increased by 2.6 mm (SD = 3.9) after surgery ($P < 0.001$), while, the lower lip distance to E-line decreased slightly by 0.9 mm (SD = 3.2) ($P < 0.01$). Nasolabial angle was decreased by 9.5° (SD = 9.4) after surgery ($P < 0.001$). The nose prominence also decreased from 18.2 mm (SD = 3.5)–16.5 mm (SD = 3.3) [Table 4].

Discussion

All the subjects of this study had moderate to severe Class III malocclusion discrepancy indicated by the low presurgical mean ANB of -3.3 (SD = 3.4) and Wits values of -10 mm (SD = 5.5), respectively.

As the result shows improvement in the hard and soft tissue variables were achieved in all patients following bimaxillary orthognathic surgery. Postsurgical values showed normalization of both the ANB and Wits.

The number of patients with SNA of normal range (80°–84°) decreased from 36 preoperatively to 23 postoperatively. We observed that the number of patients with SNA of more than 84° increased from 13 preoperatively to 52 postoperatively. The number of patients with SNA of less than 80° decreased from 47 preoperatively to 21 postoperatively.

The number of patients with SNB of normal range (78°–82°) increased from 23 preoperatively to 43 postoperatively. We observed that the number of patients with SNB of more than 82° decreased from 57 preoperatively to 35 postoperatively. The number of patients with SNB of less than 78° increased from 16 preoperatively to 18 postoperatively.

Soft tissue profile changes were significantly altered because of the surgery. All subjects presurgically presented a concave profile and a protrusive lower lip. The bimaxillary surgery improved the facial convexity, NA, PN, and upper and lower lip to E-line [Table 4]. The dental changes such as decrease of upper incisor to SN and increase of IMPA were achieved by presurgical orthodontics [Table 3]. A combination of hard tissue, soft tissue, and dental changes improved the aesthetic outcome of the patients as shown in our result.

In a similar study by Lin and Kerr on 17 non-growing dentate Class III subjects treated by bimaxillary surgery, the mean ANB value was -3.65.[9] They found out a similar result, upper lip to E-line increased significantly while Lower Lip to E-line showed decrease significantly.

Table 1: Sagittal parameters

Cephalometric index	(T1)	(T2)	Differences	*P*
SNA (°)	79.7 (4.8)	83 (5)	3.3 (3.4)	0.001*
SNB (°)	83 (5.5)	80.7 (5)	−2.3 (3)	0.001*
ANB (°)	−3.3 (3.4)	2.3 (3.3)	5.6 (3.8)	0.001*
Wits (mm)	−10 (5.5)	−3 (4,4)	7 (4)	0.001*

SNA: Sella, nasion, A point, SNB: Sella, nasion, B point, ANB: A point, nasion, B point, T1: Presurgical cephalograms, T2: Postsurgical cephalograms

Table 2: Vertical parameters

Cephalometric index	(T1)	(T2)	Differences	*P*
Ar-Go-Me°	131.5 (7.8)	130.5 (7.5)	−1 (5.5)	0.08
NL to NSL°	7.2 (4)	8 (5.1)	0.8 (3.5)	0.08
ML to NSL°	35.7 (6.6)	36 (6.3)	0.3 (4.4)	0.08

Ar-Go-Me: Angle between articular, gonion and menton, NL to NSL: Maxillary inclination relative to the cranial base, ML to NSL: Mandibular inclination relative to the cranial base, T1: Presurgical cephalograms, T2: Postsurgical cephalograms

Table 3: Dental parameters

Cephalometric index	(T1)	(T2)	Differences	*P*
U1 to SN°	106.7 (8.8)	104.9 (8.6)	−1.8 (8.7)	0.05
IMPA°	81.7 (9.9)	86.5 (7.7)	4.8 (7.2)	0.001

U1 to SN: Angle between long axis upper central incisor and anterior cranial base, IMPA: Angle between the long axis of the lower central incisor and mandibular plane, T1: Presurgical cephalograms, T2: Postsurgical cephalograms

Table 4: Soft tissue cephalometric index

Cephalometric index	(T1)	(T2)	Differences	*P*
Upper lip-E	−8.3 (3.3)	−5.7 (3.7)	2.6 (3.9)	0.001*
Lower lip-E	−2.5 (3.3)	−3.4 (3)	−0.9 (3.2)	0.01*
Nasolabial angle	110 (12.5)	100.6 (12.2)	−9.5 (9.4)	0.001*
PN (mm)	18.2 (3.5)	16.5 (3.3)	−1.7 (2.8)	0.001*
Pg′ (mm)	13 (3)	13 (4)	0 (3.9)	0.7
Upper lip length (mm)	21.9 (4.3)	23.7 (4.4)	1.8 (3.7)	0.001*
Lower lip length (mm)	46.5 (7.5)	48.1 (6.1)	1.6 (8.7)	0.08
Cervical length (mm)	50.6 (10)	47.9 (10)	−2.7 (10.5)	0.01*

PN: Nose prominence (PN), Pg′: Soft tissue chin thickness, T1: Presurgical cephalograms, T2: Postsurgical cephalograms. *Statistically significant; *P* value set at 0.05

Marsan *et al.*,[10] assessed the results of bimaxillary surgery on 44 Turkish female subjects presenting with Class III malocclusions. Similarly, in their study, the maxilla moved anteriorly and pogonion moved posteriorly. However, in their study nasal tip and NA increased while they showed decreased in this study. Although a tip rotation has been reported. It should be mentioned that the analysis in this study were 2-dimensional (2D) and it did not take into consideration the changes in the medio-lateral direction.

We also agree with the result of Esenlik *et al.*,[11] which showed a little difference after two different maxillary procedures (only advancement, advancement and impaction) on the postoperative nasal profile.

In our study we had a large sample, where we documented many different variable affecting the soft tissue changes thoroughly. We performed 2D evaluation however; using 3-dimensional analysis is used increasingly.

Although in many cases we did not have a SNA angle or SNB angle in normal range but a good aesthetic outcome have been observed. Consequently our study showed that soft tissue change and aesthetic aspects should be considered in surgical planning and not only concentrating on achieving SNA angle or SNB angle of normal range. As we could show the advancement of maxilla will achieve a better lip and nose profile.

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